NUCLEAR FUEL COSTS

1.0 PURPOSE

The purpose of this evidence is to describe OPG’s nuclear fuel supply, set out the forecast of nuclear fuel costs over the calendar years 2005 to 2009, and identify key cost drivers and assumptions.

2.0 NUCLEAR FUEL SUPPLY

2.1 General

The accountability for developing supply strategies, executing procurement processes and administering nuclear fuel supply contracts rests with the Nuclear Supply Chain. OPG’s nuclear fuel supply strategy is reviewed and approved by the Chief Executive Officer following review by the Chief Operating Officer, Chief Nuclear Officer, and Chief Financial Officer.

The nuclear fuel supply objectives and strategies are:

- High Quality: Fuel quality is assured by sourcing from suppliers that conform to the various Canadian Standards Association CAN3-Z299 quality standards. Supplier quality assurance program conformance is verified by OPG through source surveillance and audit.

- Security of Supply: OPG must ensure that its reactors are not shut down due to lack of fuel, and in that respect must ensure that each step in the supply chain is not substantially delayed due to lack of materials.

- Cost: OPG seeks to obtain supply at the lowest cost consistent with the above objectives.

OPG’s nuclear fuel procurement strategies take into account new fuel requirements, existing inventories, existing supply arrangements and fuel supply market conditions.

OPG’s standard procurement practice for nuclear fuel is to issue a request for proposals to a pre-determined group of suppliers, and to then evaluate proposals against pre-determined
evaluation criteria that include quality, security of supply and costs. However, OPG may also
review and accept unsolicited proposals on a case-by-case basis.

OPG’s nuclear fuel supply chain is made up of the following stages:

- The purchase of uranium concentrate.
- The purchase of services for the conversion of uranium concentrate to uranium dioxide.
- The purchase of services for the manufacture of fuel bundles containing the uranium
dioxide.

OPG currently purchases each of these components separately and maintains ownership of
the uranium throughout the supply chain. Nuclear fuel inventories are discussed at Ex. B1-
T1-S1 Section 3.2.2.

All of OPG’s nuclear stations incorporate heavy water moderated CANDU (Canadian
Deuterium Uranium) reactors. The fuel used in a CANDU reactor contains the naturally
occurring proportion of the $^{235}$U isotope (0.7 percent). The supply chain for the required
uranium conversion and fuel bundle manufacturing services for CANDU reactors is limited
because the majority of the world’s reactors are light water reactors, which require
conversion of uranium concentrate to uranium hexafluoride and enrichment to a higher
proportion of the $^{235}$U isotope.

The CANDU fuel bundle is an integral assembly of hermetically sealed, zirconium clad,
cylindrical fuel elements containing ceramic uranium dioxide pellets. Each Pickering reactor
uses fuel bundles that have a 28-element configuration. Each Pickering A reactor (Units 1
and 4) has 390 fuel channels containing 12 fuel bundles each (4,680 bundles per reactor).
Each Pickering B reactor (Units 5 through 8) has 380 fuel channels containing 12 fuel
bundles each (4,560 bundles per reactor). Each Darlington reactor uses fuel bundles that
have a 37-element configuration. Each Darlington reactor has 480 fuel channels containing
13 fuel bundles each (6,240 bundles per reactor).
2.2 Fuel Planning

OPG’s fuel procurement planning begins with a forecast of fuel bundle reactor loading requirements. The quantity of fuel bundles required for normal fueling is determined by converting OPG’s forecast of electrical energy production, as referenced at Ex. E2-T1-S1, into a forecast of fuel bundles required for fueling (“usage”) using forecasts of fuel burn-up and reactor thermal efficiency rates.

OPG maintains inventories at each stage of the nuclear fuel supply chain. An inventory of fuel bundles equivalent to 12 months of expected forward usage is maintained to allow continued fueling in the event of a disruption in the supply of fuel bundles or uranium conversion. A working inventory of uranium dioxide is maintained to feed the fuel manufacturing process and an inventory of uranium concentrates and recycled uranium dioxide scrap from the manufacturing process is maintained to feed the production of uranium dioxide.

From the forecast of fuel bundle requirements, and with consideration of existing inventories, OPG can then work backwards to first determine its need for delivery of new manufactured fuel bundles, which in turn determines the need for uranium dioxide conversion services and then the need to procure and deliver new supplies of uranium concentrates.

The annual quantities to meet usage and inventory requirements from 2007 - 2009 are shown below in Chart 1:

<table>
<thead>
<tr>
<th>Requirements (000 kgU)</th>
<th>2007 Actual</th>
<th>2008 Plan</th>
<th>2009 Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium Concentrates</td>
<td>721</td>
<td>792</td>
<td>760</td>
</tr>
<tr>
<td>Uranium Conversion</td>
<td>749</td>
<td>830</td>
<td>792</td>
</tr>
<tr>
<td>28-element Fuel Bundles</td>
<td>247</td>
<td>300</td>
<td>425</td>
</tr>
<tr>
<td>37-element Fuel Bundles</td>
<td>443</td>
<td>475</td>
<td>335</td>
</tr>
</tbody>
</table>
2.3 Fuel Bundle Manufacturing

A key objective in fuel bundle manufacturing is high quality. An improperly manufactured fuel bundle is more likely to fail within a reactor and create additional costs to locate and remove the defective fuel bundle as well as purify and decontaminate reactor systems. This could potentially lead to reactor shutdown and an increased radiological risk. As such, OPG requires the manufacturing process to conform to the Canadian Standards Association quality standard CAN3-Z299.1 to ensure that all phases, including design, procurement, manufacturing and inspection are appropriately controlled. OPG performs surveillance of all manufacturing processes and verifies conformance to quality standard CAN3-Z299.1.

OPG currently has a supply contract with one of the two domestic CANDU fuel bundle manufacturing suppliers. Most other countries using CANDU reactors have purchased or developed their own manufacturing capabilities. However these offshore facilities are not qualified by OPG nor do they have capacity available to produce the 28-element and 37-element fuel designs required for OPG reactors. OPG’s supplier has a well developed quality program and OPG has not had a manufacturing-related defect from this supplier in over 15 years.

Pricing under this contract is volume dependant and indexed to such factors as inflation and foreign exchange rates.

2.4 Uranium Conversion

The supplier’s processes must conform to the Canadian Standards Association quality standard CAN3-Z299.2 to ensure that all phases, including procurement, manufacturing, and inspection, are appropriately controlled. OPG performs surveillance of the conversion process and verifies conformance to the quality standard.

OPG has a supply contract with the sole domestic supplier of uranium conversion services, which covers requirements through the test period. OPG generally maintains a two to three month uranium dioxide working inventory and the supplier is also contractually required to
maintain an inventory of certified uranium dioxide for OPG’s use in the event of a supply interruption. Pricing under this contract is volume dependant and indexed to inflation.

2.5 Uranium Concentrates

2.5.1 Overview

OPG’s strategy for the supply of uranium concentrates is to maintain an adequate level of supply for future years based on existing inventory levels, contractual arrangements for future delivery, and planned future purchases. OPG maintains a portfolio of uranium concentrates supply arrangements, diversified by source, contract term, and pricing mechanism.

Portfolio diversity provides supply security ensuring that a supply disruption from any single supplier would not impact on OPG’s entire supply. Portfolio diversity also reduces cost volatility.

OPG’s uranium concentrate requirements are expected to be met over 2008 and 2009 through deliveries under existing contracts with five suppliers, and the partial drawdown of existing inventories. Over the 2008 - 2009 period, existing contracts will provide 1,348,000 kgU and inventory will provide 204,000 kgU.

The existing contracts for uranium concentrates were entered into over the 2004 to 2007 period and contain a mixture of pricing provisions. Under contracts with market-related pricing terms, quantities are priced at market price, established at or near the time of delivery. Contracts with indexed pricing include base prices, set at the time of contract signing, but which escalate to the time of delivery by formula or by published indexes. The quantities of contract deliveries for the existing contracts are shown by year and by pricing category (market-related and indexed pricing) in Chart 2 below:
Chart 2

Existing Contracts by Pricing Category

<table>
<thead>
<tr>
<th>Pricing Category</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Related (000's kgU)</td>
<td>255</td>
<td>524</td>
<td>192</td>
<td>971</td>
</tr>
<tr>
<td>Indexed (000's kgU)</td>
<td>301</td>
<td>301</td>
<td>331</td>
<td>933</td>
</tr>
<tr>
<td>Total</td>
<td>556</td>
<td>825</td>
<td>523</td>
<td>1904</td>
</tr>
</tbody>
</table>

2.5.2 Market Conditions

Over the 15 years prior to 2003, the uranium market was generally characterized by stable demand and a drawdown of worldwide inventories. This resulted in declining market prices, a consolidation of suppliers, as well as limited investment in uranium mine expansion and new development. By 2003, as much as 40 percent of annual worldwide uranium requirements were being satisfied by the drawdown of inventories. The sources of these inventories included government and utility inventories built up in expectation of significant nuclear programs which did not materialize, the flow of material to the western world following the breakup of the Soviet Union, and the use of uranium formerly contained in weapons as nuclear fuel.

Starting in 2003, demand for uranium began to increase in response to a number of factors including; supply disruption events which highlighted the production risks (including floods in Saskatchewan and Australian mines and a fire in an Australian mill), a renaissance of nuclear programs worldwide, particularly in Asia, and the realization of limits to inventory reductions. On the supply side, significant exploration is currently occurring and investments are being made in new uranium mining projects around the world. However, the lead time between discovery of an economic deposit and production of uranium in the western world is ten years or more, driven largely by regulatory requirements. Therefore, the combination of speculative demand, modest real growth in demand, the prospect of future growth in nuclear generation, temporary losses from current production and the lag in new uranium production has created a strong seller’s market. Spot market prices increased to an all time peak of US $136 per pound (US $354 per kgU) in 2007 before declining to around US $90 per pound.
(US $234 per kgU), as shown in the following Figure 1.0 based on the Ux Consulting Company's U308 weekly spot price, and this has impacted OPG's market priced and indexed contracts.

Figure 1.0

UxC Price Indicators- Current and Forecast

Suppliers are now demanding long-term commitments from buyers, largely based on the supplier's contract terms and conditions, with market-related prices (at time of delivery) and "floor prices" above US $50 per pound (US $130 per kgU). This situation is expected to continue at least through 2010, when additional supplies are expected to come into the market in response to higher prices.

The majority of worldwide uranium purchases (approximately 90 percent by volume) are provided under long term contracts. The remainder is traded on the spot market, defined as having delivery within one year. OPG has recently implemented a revised spot market procurement process to facilitate potential future spot market purchasing. While a number of market observers publish spot market price indicators based on physical spot market trading in uranium, the financial derivative markets for uranium (i.e., NYMEX futures; over the counter) is still in the developmental phase.
3.0 NUCLEAR FUEL COST FORECAST

The nuclear fuel cost forecast for the calendar years 2008 and 2009 is shown in Ex. F2-T5-S1 Table 1 along with comparable figures for 2005 through 2007. The nuclear fuel costs as shown in Ex. F2-T5-S1 Table 1 represent the total cost of each finished fuel bundle in aggregate as it is loaded into a reactor. The nuclear fuel costs in Ex. F2-T5-S1 Table 2 are the same as Ex. F2-T5-S1 Table 1, but restated in $/MWh.

The total cost of a finished fuel bundle as it is loaded into a reactor includes the cost of each of the three components (uranium concentrate, uranium conversion, and fuel bundle manufacturing). In that regard, the relative weighting of the cost of the uranium concentrate to the total cost of the finished fuel bundle as it is loaded into a reactor is expected to shift from approximately 36 percent in 2006 to a forecasted 63 percent uranium concentrate in 2009. The higher percentage of costs reflects the recent market price increases as discussed in section 2.5.2 above. Indeed, with the increased volatility associated with the price of uranium concentrates, there is a great deal of uncertainty related to predicting future nuclear fuel costs. By comparing high and low industry uranium concentrate price forecasts against OPG’s current base forecast, OPG has recently calculated a potential variance range of +$24M / –$7M in 2009 nuclear fuel costs as loaded into the reactor. For these reasons, OPG is proposing to establish a Nuclear Fuel Cost variance account to address fuel cost risk as described in Ex. J1-T3-S1.

Exhibit F2-T5-S1 Table 1 also includes costs related to nuclear used fuel management services as discussed at Ex. H1-T1-S2, and fuel oil which are used to run stand-by generators.

The key cost drivers impacting the year-over-year increases in nuclear fuel costs as shown in Ex. F2-T5-S1 Table 1 are:

- Uranium concentrate contract price increases under market priced and indexed contracts.
- Escalation of uranium conversion service and fuel bundle manufacturing contract prices at general inflation rates.
• Changes in OPG energy production, e.g., the return to service of Unit 1 at Pickering A for a full year of operations in 2006.

Explanations of nuclear fuel cost variances are more fully described at Ex. F2-T5-S2.